

ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R - 2009

M.TECH. BIOTECHNOLOGY

I SEMESTER (FULL TIME) CURRICULUM AND SYLLABI

SEMESTER I

SL. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	BT 9250 BT 9251 BT 9252	Molecular Fundamentals in biology * Fundamentals of chemical engineering ** Enzyme technology and Industrial applications ***	3	0	0	3
2	BT 9211	Biochemical engineering and Fermentation Technology	3	0	0	3
3	BT 9212	Computational Biology	2	0	2	3
4	BT 9213	IPR and Biosafety	3	0	0	3
5	E1	Elective 1	3	0	0	3
6	E2	Elective 2	3	0	0	3
7	E3	Elective 3	3	0	0	3
PRACTICAL						
8	BT 9214	Preparative and analytical techniques in biotechnology	0	0	6	3
TOTAL			20	0	8	24

* Is meant for students who have (Non-BioTech) B.E / B. Tech. degree

** Is meant for students who have (Science and Biology) M.Sc. degree

***Is meant for students who have (Bio Technology) B.Tech.degree

ELECTIVES FOR M.TECH. BIOTECHNOLOGY

SEMESTER I

SL. No	COURSE CODE	COURSE TITLE	L	T	P	C
1	BT 9253	Applied Mathematics for Biotechnologists	3	0	0	3
2	BT 9254	Applicable Mathematics for Biotechnologists	3	0	0	3
3	BT 9255	Unix Operating System and Programming Language C++	3	0	0	3
4	BT 9256	Food Processing and Biotechnology	3	0	0	3
5	BT 9257	Pharmaceutical Biotechnology	3	0	0	3
6	BT 9258	Environmental Biotechnology	3	0	0	3
7	BT 9259	Communication skills and personality development	3	0	0	3

UNIT I INTRODUCTION TO BIOLOGICAL MOLECULES 9
Basic Carbon Chemistry, Types of biomolecules, Molecular structure and function of Biological Macromolecules - Proteins, Nucleic acids, Carbohydrates, Lipids

UNIT II GENES TO METABOLIC END-PRODUCTS 9
Basics of DNA replication, transcription, translation, biocatalysis, pathways and metabolism

UNIT III MOLECULAR CELL BIOLOGY AND ENERGETICS 9
Functional organization of cells at molecular level; membranes, molecular communication across membranes, energetics – proton motive force, ATP synthesis, respiration; photosynthesis

UNIT IV MOLECULAR BASIS OF MICROBIAL FORMS AND THEIR DIVERSITY 9
Structural differences between different microbial cell types; over view of primary and secondary metabolism of microbes, commercial products like antibiotics, vitamins from microbes

UNIT V MOLECULAR BASIS OF HIGHER LIFE FORMS 9
Molecular differences between various eukaryotic cell types, tissue proteins, blood, important molecular components of blood, albumin, antibodies, hormones and their actions

TOTAL : 45 PERIODS

TEXT / REFERENCES

1. Interactive Concepts in Biochemistry by Rodney Boyer, Copyright 2002, John Wiley & Sons Publishers, Inc
<http://www.wiley.com/legacy/college/boyer/0470003790/index.htm>
2. Biochemistry by Lubert Stryer, 5th Edition W. H. Freeman and Company, New York
3. Lehninger's Principles of Biochemistry, 4th Edn, by David L. Nelson and Michael M. Cox,
4. Molecular Cell Biology, Sixth Edition., by [Harvey Lodish](#), [Arnold Berk](#), [Chris A. Kaiser](#), [Monty Krieger](#), [Matthew P. Scott](#), [Anthony Bretscher](#), [Hidde Ploegh](#), [Paul Matsudaira](#)
5. Bioenergetics at a Glance: An Illustrated Introduction [D. A. Harris](#), 1995 John Wiley & Sons Publishers, Inc
6. Introduction to General, Organic, and Biochemistry, 8th Edition Morris Hein, Leo R. Best, Scott Pattison, Susan Arena 2004, John Wiley & Sons Publishers, Inc
7. An Introduction to Molecular Biotechnology: Molecular Fundamentals, Methods and Applications in Modern Biotechnology Michael Wink (Editor) 2006 John Wiley & Sons Publishers, Inc

UNIT I	INTRODUCTION	5
Introduction to chemical engineering sciences and its role in the design & analysis of chemical processes. Overview of unit operations and processes in the chemical industry. Units and conversion factor. Introduction to Dimensional analysis.		
UNIT II	MATERIAL AND ENERGY BALANCES	13
Overall and component material balances - Material balances without chemical reactions - Chemical reactions -stoichiometry - conversion and yield - Material balance calculations with chemical reactions – combustion calculations - recycle operations. Energy balances - Entropy - Latent heat - Chemical reactions - combustion. Concepts of chemical thermodynamics, the relation to VLE, solution thermodynamics and reaction thermodynamics.		
UNIT III	FLUID MECHANICS	9
Properties of fluids; Fluid statics – forces at fluid surfaces, Pressure and measurement of pressure differences; Fluid flow concepts and basic equations of fluid flow – continuity equation and Bernoulli's equation; shear stress relationship and viscous effects in fluid flow; non newtonian fluids; significance of dimensionless groups in fluid flow operations.		
UNIT IV	TRANSPORTATION OF FLUIDS	9
Different types of pumps, compressors and valves. Measurement of fluid flow using hydrodynamic methods, direct displacement method. Types of agitators, flow patterns in agitated vessels, calculation of power consumption – applications in bioreactor design		
UNIT V	HEAT TRANSFER	9
Nature of heat flow - Conduction, convection, radiation. Steady state conduction, Principles of heat flow in fluids, Heat transfer by forced convection in laminar and turbulent flow. Heat exchange equipments- principles and design.		

TOTAL : 45 PERIODS

REFERENCES

1. Bhatt B.I., Vora S.M. Stoichiometry. 3rd ed., Tata McGraw-Hill, 1977.
2. McCabe W.L., *et al.*, Unit Operations In Chemical Engineering. 6th ed., McGraw-Hill Inc., 2001.
3. Geankoplis C.J. Transport Processes And Unit Operations. 3rd ed., Prentice Hall India, 2003.

UNIT I KINETICS AND MECHANISM OF ENZYME ACTION 8

Classification of enzymes; quantification of enzyme activity and specific activity. Estimation of Michaelis Menten parameters, Effect of pH and temperature on enzyme activity, kinetics of inhibition. Modeling of rate equations for single and multiple substrate reactions.

UNIT II IMMOBILISED ENZYME REACTIONS 9

Techniques of enzyme immobilisation-matrix entrapment, ionic and cross linking, column packing; Analysis of mass transfer effects of kinetics of immobilised enzyme reactions; Analysis of Film and Pore Diffusion Effects on Kinetics of immobilized enzyme reactions; calculation of Effectiveness Factors of immobilized enzyme systems; Bioconversion studies with immobilized enzyme packed -bed reactors.

UNIT III MASS TRANSFER EFFECTS IN IMMOBILISED ENZYME SYSTEMS 5

Analysis of film and Pore diffusion Effects on kinetics of immobilised enzyme reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors

UNIT IV APPLICATION OF ENZYMES 12

Extraction of commercially important enzymes from natural sources; Commercial applications of enzymes in food, pharmaceutical and other industries; enzymes for diagnostic applications. Industrial production of enzymes. Use of enzymes in analysis-types of sensing-gadgetry and methods. Case studies on application - chiral conversion, esterification etc.,

UNIT V ENZYME BIOSENSORS 11

Applications of enzymes in analysis; Design of enzyme electrodes and case studies on their application as biosensors in industry, healthcare and environment.

TOTAL: 45 PERIODS

REFERENCES

1. Blanch, H.W., Clark, D.S. Biochemical Engineering, Marcel Dekker, 1997 Lee, James M. Biochemical Engineering, PHI, USA.
2. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill, 1986
3. Wiseman, Alan. Hand book of Enzyme Biotechnology, 3rd ed., Ellis Harwood 1995.

UNIT I	INTRODUCTION TO COMPUTATIONAL BIOLOGY	7
Molecular sequences. Sequence analysis. Dynamic programming. Pairwise and multiple sequence alignment and motifs. Applications.		
UNIT II	DATABASES	6
Scoring matrices, heuristic methods of database searching: BLAST family of programs, FASTA. Phylogenetic trees.		
UNIT III	INTRODUCTION TO GENOMICS AND PROTEOMICS	10
Functional, structural and comparative genomics. Gene finding and annotation. Protein structure. Homology modeling. Differential gene expression.		
UNIT IV	MACHINE LEARNING TECHNIQUES	12
Hidden Markov models, Neural nets, Decision trees and their application in computational biology. Eukaryotic and prokaryotic gene finding. DNA Computing.		
UNIT V	INTRODUCTION TO PERL	10
Variables, Data types, control flow constructs, arrays, lists and hashes, String manipulation, File handling.		

LAB:

Sequence analysis	: Pairwise and multiple sequence alignment. Tools available for sequence analysis. Motif generation.
Databases	: Exploring biological databases
Database searching	: Using BLAST, PSIBLAST and PHIBLAST, FASTA.
Gene finding	: Using Genscan, HMMGene etc.
Protein structure	: Tools for protein structure prediction.
Prediction	
Annotation	: Functional annotation. Writing utilities using Perl.

TOTAL: 60 PERIODS**REFERENCES**

1. Gusfield, Dan. Algorithms on strings Trees and Sequences, Cambridge University Press.
2. Baldi, P., Brunak, S. Bioinformatics: The Machine Learning Approach, 2nd ed., East West Press, 2003
3. Mount D.W. Bioinformatics: Sequence and Genome Analysis, Cold Spring Harbor Laboratory Press, 2001.
4. Baxevanis A.D. and Oullette, B.F.F. A Practical Guide to the Analysis of Genes and Proteins, 2nd ed., John Wiley, 2002
5. Tisdall, James, Beginning PERL for Bioinformatics, O'Reilley, 2001.6. Durbin, R. et al., Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press, 1998.

UNIT I INTRODUCTION TO INTELLECTUAL PROPERTY 9

Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies

UNIT II AGREEMENTS AND TREATIES 9

History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 1970 & recent amendments

UNIT III BASICS OF PATENTS AND CONCEPT OF PRIOR ART 9

Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO, esp@cenet(EPO), PATENTSCOPE(WIPO), IPO, etc.)

UNIT IV PATENT FILING PROCEDURES 9

National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes Patent licensing and agreement Patent infringement- meaning, scope, litigation, case studies

UNIT V BIOSAFETY 9

Introduction; Historical Background; Introduction to Biological Safety Cabinets; Primary Containment for Biohazards; Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication; Overview of National Regulations and relevant International Agreements including Cartagena Protocol.

TOTAL : 45 PERIODS**TEXTS/REFERENCES**

1. BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
2. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007

1. Preparation of Acetate, Tris and Phosphate Buffer systems and validation of Henderson-Hasselbach equation.
2. Reactions of amino acids – Ninhydrin, Pthaldehyde, Dansyl chloride – measurement using colorimetric and fluorimetric methods.
3. Differential estimations of carbohydrates – reducing vs non-reducing, polymeric vs oligomeric, hexose vs pentose
4. Estimation of protein concentration using Lowry's method, Dye-binding method
5. DNA determination by UV-Vis Spectrophotometer – hyperchromic effect
6. Separation of lipids by TLC.
7. Enzyme Kinetics: Direct and indirect assays – determination of K_m , V_{max} and K_{cat} , K_{cat}/K_m .
8. Restriction enzyme – Enrichment and unit calculation
9. Ion-exchange Chromatography – Purification of IgG and Albumin
10. Gel filtration – Size based separation of proteins
11. Affinity chromatography – IMAC purification of His-tagged recombinant protein
12. Assessing purity by SDS-PAGE Gel Electrophoresis
13. Chemical modification of proteins – PITC modification of IgG and Protein immobilization

TOTAL : 90 PERIODS

REFERENCES

1. Biochemical Methods: A Concise Guide for Students and Researchers, Alfred Pingoud, Claus Urbanke, Jim Hoggett, Albert Jeltsch, 2002 John Wiley & Sons Publishers, Inc,
2. Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry, 2nd Edition, Irwin H. Segel, 1976 John Wiley & Sons Publishers, Inc,
3. Principles and Techniques of Practical Biochemistry- Wilson, K. and Walker, J. Cambridge Press.

BT 9221

BIOSEPARATION TECHNOLOGY

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UNIT I INTRODUCTION TO BIOSEPARATION

4

Characterization of biomolecules and fermentation broth. Guidelines to recombinant protein purification.

UNIT II SOLID-LIQUID SEPARATION AND CELL DISRUPTION

6

Solid liquid separation- microfiltration and centrifugation – theory and design for scaleup operation. Cell disruption – Homogeniser , dynamill – principle, factors affecting disruption, batch and continuous operation. Cell disruption by chemical methods.

UNIT III CONCENTRATION AND PURIFICATION

7

Liq- liq extraction – theory and practice with emphasis on Aqueous two phase extraction. Solid liquid extraction. Precipitation techniques using salt and solvent. Separation by ultrafiltration, Dialysis, Electrophoresis.

UNIT IV CHROMATOGRAPHY

15

Theory, practice and selection of media for – Gelfiltration chromatography, Ion exchange chromatography, Hydrophobic interaction chromatography, reverse phase chromatography, Affinity chromatography – Metal affinity chromatography, dye affinity chromatography, immunosorbent affinity chromatography & Expanded bed chromatography. Scaleup criteria for chromatography, calculation of no of theoretical plates and design

UNIT V FINAL POLISHING AND CASE STUDIES

13

Freeze drying, spray drying and crystallization. Purification of cephalosporin, aspartic acid, Recombinant Streptokinase, Monoclonal antibodies, Tissue plasminogen activator, Taq polymerase, Insulin.

TOTAL : 45 PERIODS

REFERENCES

1. Belter,P.A. et al., Bioseparations: Downstream Processing For Biotechnology, John-Wiley , 1988
2. Janson J.C, & Ryden L. Protein Purification: Principles, High Resolution Methods And Applications, VCH Pub. 1989.
3. Scopes R.K. – Protein Purification – Principles And Practice, Narosa , 1994.

BT 9222

ADVANCED GENETIC ENGINEERING

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UNIT I CLONING AND EXPRESSION OF GENES

10

Cloning vehicles, restriction enzymes, restriction modification, linkers, adaptors, homopolymeric trailing, restriction mapping
Expression and purification of recombinant proteins, prokaryotic and eukaryotic expression vectors, in vivo homologous recombination, large scale expression and purification of proteins.

UNIT II LIBRARY CONSTRUCTION

8

cDNA & genomic DNA library construction and screening, preparation of DNA, RNA probes immunoscreening and blotting techniques, etc

UNIT III SEQUENCING 10
Methodology – Chemical & enzymatic, Automated sequence, Genome sequencing methods – top down approach, bottom up approach.

UNIT IV PCR AND MUTAGENESIS 7
PCR principle, applications, different types of PCR, mutagenesis and chimeric protein engineering by PCR, RACE, Kuntels' method of mutagenesis.

UNIT V GENE TRANSFER & GENE THERAPY 10
Introduction of foreign genes into plant and animal cells, creation of transgenic plants and animal knockouts, gene therapy, types and vectors.

TOTAL : 45 PERIODS

REFERENCES

1. Primrose S.B., Twyman R.H. and Old R.W. Principles of Gene Manipulation, 6th ed., Blackwell Science, 2001
2. Winnacker E.L. From Genes to clones : Introduction to Gene Technology, Panima, 2003
3. Glick B.R. and Pasternak J.J. Molecular Biotechnology: Principles and applications of recombinant DNA, 3rd ed., ASM Press, 2003
4. Lemonie, N.R. and Cooper, D.N. Gene therapy, BIOS Scientific, 1996

**BT 9223 IMMUNOTECHNOLOGY L T P C
3 0 0 3**

UNIT I INTRODUCTION 12
Cells of the immune system and their development; primary and secondary lymphoid organs; humoral immune response; cell mediated immune responses; complement.

UNIT II ANTIBODIES 10
Monoclonal antibodies and their use in diagnostics; ELISA; Agglutination tests; Antigen detection assay; Plaque Forming Cell Assay.

UNIT III CELLULAR IMMUNOLOGY 12
PBMC separation from the blood; identification of lymphocytes based on CD markers; FACS; Lymphoproliferation assay; Mixed lymphocyte reaction; Cr51 release assay; macrophage cultures; cytokine bioassays- IL2, gamma IFN, TNF alpha.; HLA typing.

UNIT IV VACCINE TECHNOLOGY 6
Basic principles of vaccine development; protein based vaccines; DNA vaccines; Plant based vaccines; recombinant antigens as vaccines; reverse vaccinology

UNIT V DEVELOPMENT OF IMMUNOTHERAPEUTICS: 5
Engineered antibodies; catalytic antibodies; idiotypic antibodies; combinatorial libraries for antibody isolation.

TOTAL : 45 PERIODS

REFERENCES

1. Roitt, Ivan. Essential Immunology, 9th ed., Blackwell Scientific, 1997
2. Roitt I., Brostoff J. and Male D. Immunology, 6th ed. Mosby, 2001
3. Goldsby , R.A., Kindt, T.J., Osborne, B.A. and Kerby J. Immunology, 5th ed., W.H. Freeman, 2003
4. Weir, D.M. and Stewart, J. Immunology, 8th ed., Cheerchill, Linvstone, 1997

BT 9224

ANIMAL BIOTECHNOLOGY

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UNIT I INTRODUCTION 4

Scope of Animal Biotechnology, Animal Biotechnology for production of regulatory proteins, blood products, vaccines, hormones and other therapeutic proteins.

UNIT II MOLECULAR BIOLOGY 9

Biology of animal viral vectors- SV40, adeno virus, retrovirus, vaccinia virus, herpes virus, adeno associated virus and baculo virus.

UNIT III CELL CULTURE TECHNOLOGY 11

Culturing of cells, primary and secondary cell lines, Cell culture-Scaling up of animal cell culture-monolayer culture, suspension culture; Various bio-reactors used for animal cell culture-Roller bottle culture; Bioreactor process control, stirred animal cell culture, Air-lift fermentor, Chemostat/Turbidostat; High technology vaccines; Hybridoma technology; Cell lines and their applications

UNIT IV GENETIC ENGINEERING 11

Gene therapy-prospects and problems; Knock out mice and mice model for human genetic disorder; Baculo virus in biocontrol; Enzymes technology, Somatic manipulation of DNA, Nucleic acid hybridization and probes in diagnosis- preparation of probes, evaluation and applications.

UNIT V APPLICATIONS 10

Rumen manipulation- probiotics embryo transfer technology, invitro fertilization, transgenesis- methods of transferring genes into animal oocytes, eggs, embryos and specific tissues by physical, chemical and biological methods; Biopharming -Transgenic animals (Mice, Cows, Pigs, Sheep, Goat, Birds and Insects); Artificial insemination and embryo transfer.

TOTAL : 45 PERIODS

REFERENCES

1. Watson, J.D., Gilman, M., Witowski J.and Zoller, M. Recombinant DNA, 2nd ed., Scientific American Books, 1983
2. Glick, B.R. and Pasternack, J.J. Molecular Biotechnology, 3rd ed., ASM Press, 2003
3. Lewin, B. Genes VIII , Pearson Prentice Hall, 2004
4. Davis J.M. Basic Cell Culture: A Practical Approach, IRL Press, 1998
5. Freshney R.I. Animal Cell Culture- a practical approach, 1987

1. Sterilization, disinfection, safety in microbiological laboratory.
2. Preparation of media for growth of various microorganisms.
3. Identification and culturing of various microorganisms.
4. Staining and enumeration of microorganisms.
5. Growth curve, measure of bacterial population by turbidometry and studying the effect of temperature, pH, carbon and nitrogen.
6. Selection of animals, Preparation of antigens, Immunization and methods of bleeding, Serum separation, Storage.
7. Antibody titre by ELISA method.
8. Double diffusion, Immuno-electrophoresis and Radial Immuno diffusion.
9. SDS-PAGE, Immunoblotting, Dot blot assays
10. Blood smear identification of leucocytes by Giemsa stain
11. Separation of mononuclear cells by Ficoll-Hypaque
12. Immunodiagnosics using commercial kits

TOTAL : 90 PERIODS

1. Preparation of Genomic DNA
2. PCR amplification of gene from the genomic DNA
3. Preparation of plasmid DNA
4. Restriction Digestion of the vector and Insert
5. Ligation and Transformation to E.coli
6. Lysate PCR confirmation.
7. Restriction & gel elution of DNA fragments
8. Electroporation to Yeast
9. Induction experiments in E.coli using IPTG, salt etc
10. SDS-PAGE analysis of expression
11. Western blot confirmation of expressed protein (anti his)
12. ELISA (anti his) – Quantification of expressed protein.
13. RNA Isolation
14. cDNA preparation from RNA
15. Site directed mutagenesis
16. Southern hybridization experiment

TOTAL : 90 PERIODS

BT 9232

**ADVANCED BIOPROCESS AND DOWNSTREAM
PROCESSING LAB**

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1. Enzyme kinetics, inhibition, factors affecting reaction ph, temp.
2. Enzyme immobilization studies – Gel entrapment, adsorption and ion exchange immobilisation.
3. Optimization techniques – Plackett burman, Response surface methodology.
4. Batch cultivation – recombinant *E.coli* – growth rate, substrate utilization kinetics, plasmid stability, product analysis after induction, Metabolite analysis by HPLC
5. Fed batch cultivation *E.coli*, *Pichia pastoris*
6. Continuous cultivation – μ - d construction, kinetic parameter evaluation, gas analysis, carbon balancing, Pulse and shift techniques.
7. Bioreactor studies : Sterilisation kinetics, k_{La} determination, residence time distribution
8. Animal cell culture production: T-flask, spinner flask, bioreactor
9. Cell separation methods; Centrifugation and microfiltration
10. Cell disruption methos: Chemical lysis and Physical methods
11. Product concentration: Precipitation, ATPS, Ultrafiltration
12. High resolution purification; Ion exchange, affinity and Gel filtration
13. Freeze drying

TOTAL : 90 PERIODS

BT 9253

APPLIED MATHEMATICS FOR BIOTECHNOLOGISTS

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- UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9**
First order and second order-application to biology.Lagrange's method and Charpits method.
- UNITII PROBABILITY AND STATISTICS 9**
Probability –Addition theorem, Multiplication theorem and conditional probability-Baye's theorem. Binomial distribution, Poisson distribution and Normal distribution.
- UNIT III CURVE FITTING 9**
Curve fitting –fitting a straight line and second degree curve. Correlation and Regression. Fitting a non linear curve. Bivariate correlation application to biological sciences.
- UNITIV SAMPLING DISTRIBUTIONS 9**
Sampling distributions-Large samples and Small samples. Testing of Null hypothesis-Z test, t test and χ^2 test. Type I and Type II errors. Fisher's F Test. Goodness of fit.
- UNIT V DESIGN OF EXPERIMENTS 9**
Design of Experiments –One way, Two way classifications – Randomied Block Designs-Latin Square Designs.

TOTAL : 45 PERIODS

UNIT I FOOD CHEMISTRY 9
Constituent of food – contribution to texture, flavour and organoleptic properties of food; food additives – intentional and non-intentional and their functions; enzymes in food processing.

UNIT II FOOD MICROBIOLOGY 9
Sources and activity of microorganisms associated with food; food fermentation; food chemicals; food borne diseases – infections and intoxications, food spoilage – causes.

UNIT III FOOD PROCESSING 9
Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations – mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing.

UNIT IV FOOD PRESERVATION 9
Use of high temperatures – sterilization, pasteurization, blanching, aseptic canning; frozen storage – freezing curve characteristics. Factors affecting quality of frozen foods; irradiation preservation of foods.

UNIT V MANUFACTURE OF FOOD PRODUCTS 9
Bread and baked goods, dairy products – milk processing, cheese, butter, ice-cream, vegetable and fruit products; edible oils and fats; meat, poultry and fish products; confectionery, beverages.

TOTAL: 45 PERIODS

REFERENCES

1. Coultate T.P. Food – The chemistry of its components, 2nd ed., Royal society, London, 1992
2. Sivasankar B. Food processing and preservation, Prentice Hall of India Pvt.Ltd.New Delhi, 2002
3. Fennema O.R. ed. Principles of food science : Part I, Food chemistry, Marcel Dekker, New York, 1976.
4. Frazier W.C. and Westhoff D.C. Food Microbiology, 4th ed. McGram-Hill Book Co., New York, 1988
5. Brenner, J.G., Butters, J.R., Cowell, N.D. and Lilly, A.E.V. Food engineering operations, 2nd ed., Applied Sciences Pub.ltd., London,1979
6. Pyke, M. Food Science and Technology , 4th ed., John Murray, London, 1981

UNIT I INTRODUCTION 6
History of pharmacy, the pharmaceutical industry & development of drugs; economics and regulatory aspects, quality management; GMP

UNIT II	DRUG KINETICS AND BIOPHARMACEUTICS	9
Mechanism of drug absorption, distribution, metabolism and excretion – factors affecting the ADME process, bioequivalence, pharmacokinetics.		
UNIT III	PRINCIPLES OF DRUG MANUFACTURE	15
Liquid dosage forms – solutions, suspensions and emulsions, Topical applications – ointments, creams, suppositories, Solid dosage forms – powders, granules, capsules, tablets, coating of tablets, Aerosols. Preservation, packing techniques		
UNIT IV	ADVANCES IN DRUG DELIVERY	5
Advanced drug delivery systems – controlled release, transdermals, liposomes and drug targeting		
UNIT V	BIOPHARMACEUTICALS	10
Understanding principles of pharmacology, pharmacodynamics Study of a few classes of therapeutics like laxatives, antacids and drugs used in peptic ulcers, drugs used in coughs and colds, analgesics, contraceptives, antibiotics, hormones.		

TOTAL : 45 PERIODS

REFERENCES

1. Gareth Thomas. Medicinal Chemistry. An introduction. John Wiley. 2000.
2. Katzung B.G. Basic and Clinical Pharmacology, Prentice Hall of Intl. 1995.

BT 9258	ENVIRONMENTAL BIOTECHNOLOGY	L T P C
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UNIT I	OVERVIEW	9
Microbial flora of soil, growth, ecological adaptations, interactions among soil microorganisms, biogeochemical role of soil microorganisms. Environmental monitoring – sampling, physical, chemical and biological analysis, monitoring pollution		
UNIT II	BIOLOGICAL WASTEWATER TREATMENT	9
Waste water characteristics, The activated sludge process, Design and modeling of activated sludge processes, Aerobic digestion, nitrification, secondary treatment using a trickling biological filter, anaerobic digestion, mathematical modeling of anerobic digester dynamics, anaerobic denitrification, phosphate removal		
UNIT III	BIOREMEDIATION	9
Introduction, Inorganic wastes, petroleum based wastes, synthetic organic compounds, phytoremediation, gaseous wastes, desulphurisation of coal and oil.		
UNIT IV	TREATMENT OF INDUSTRIAL WASTES	9
Dairy, pulp, dye, leather, hospital and pharmaceutical industrial waste management. Solid waste management.		
UNIT V	MOLECULAR BIOLOGY	9
Latest elements, developements pertaining to environmental biotechnology.		

TOTAL: 45 PERIODS

REFERENCES

1. Stanier R.Y., Ingraham J.L., Wheelis M.L., Painter R.R., General Microbiology, Mcmillan Publications, 1989.
2. Foster C.F., John Ware D.A., Environmental Biotechnology , Ellis Horwood Ltd., 1987.
3. Chakrabarty K.D., Omen G.S., Biotechnology And Biodegradation, Advances In Applied Biotechnology Series , Vol.1, Gulf Publications Co., London, 1989.
4. Bailey J.E. & Ollis, D.F. Biochemical Engineering Fundamentals, 2nd Ed., McGraw Hill, 1986
5. Alan Scragg., Environmental Biotechnology, Longman.

BT 9259 COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT

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3 0 0 3

9

UNIT I PROCESS OF COMMUNICATION

Concept of effective communication- Setting clear goals for communication; Determining outcomes and results; Initiating communication; Avoiding breakdowns while communicating; Creating value in conversation; Barriers to effective communication; Non verbal communication- Interpreting non verbal cues; Importance of body language, Power of effective listening; recognizing cultural differences

UNIT II PRESENTATION SKILLS

12

Formal presentation skills; Preparing and presenting using Over Head Projector, Power Point; Defending Interrogation; Scientific poster preparation & presentation; Participating in group discussions

UNIT III TECHNICAL WRITING SKILLS

12

Types of reports; Layout of a formal report; Scientific writing skills: Importance of communicating Science; Problems while writing a scientific document; Plagiarism; Scientific Publication Writing: Elements of a Scientific paper including Abstract, Introduction, Materials & Methods, Results, Discussion, References; Drafting titles and framing abstracts

UNIT IV COMPUTING SKILLS FOR SCIENTIFIC RESEARCH

12

Web browsing for information search; search engines and their mechanism of searching; Hidden Web and its importance in Scientific research; Internet as a medium of interaction between scientists; Effective email strategy using the right tone and conciseness

TOTAL:45 PERIODS

TEXT/REFERENCE

Mohan Krishna and N.P. Singh, Speaking English effectively, Macmillan, 2003